(12) UK Patent Application (19) GB (11) 2 126 093 A

(21) Application No 8224174
(22) Date of filing 23 Aug 1982
(43) Application published
21 Mar 1984
(51) INT CL³
A61M 5/20
(52) Domestic classification
A5R CA
(56) Documents cited
GBA 2071501
GBA 2003387
GB 1582515
GB 1582514
GB 1582513
GB 1582512
GB 1582511
(58) Field of search
A5R
(71) Applicant
Vineland Laboratories Inc.
(USA—New Jersey),
2285 East Landis Avenue,
Vineland, New Jersey,
United States of America
(72) Inventors
Donald D. Matheson,
Wiley Adams Sanders
(74) Agent and/or Address for
Service
Graham Watt & Co.,
Riverhead, Sevenoaks,
Kent TN13 2BN

(54) Improved pneumatic vaccinator

(57) A pneumatic injection apparatus has a fluid actuated drive cylinder (30), and a cylinder rod (32) translating from a retracted position, to which it is biased, along a longitudinal axis (34) in response to fluid pressure actuation to drive a syringe displacement element (36).

An injection syringe (38) with a body having an injection liquid supply (40) and an injection needle (42) ejects liquid in response to a syringe piston slidable in response to the syringe displacement element. A fluid supply for actuating the cylinder includes a supply conduit to a supply of fluid under pressure, an actuating conduit to the drive cylinder, and, between them, a valve adapted to respond to an increase in fluid pressure input from the supply conduit by supplying the actuating conduit with fluid only long enough to actuate the cylinder once.

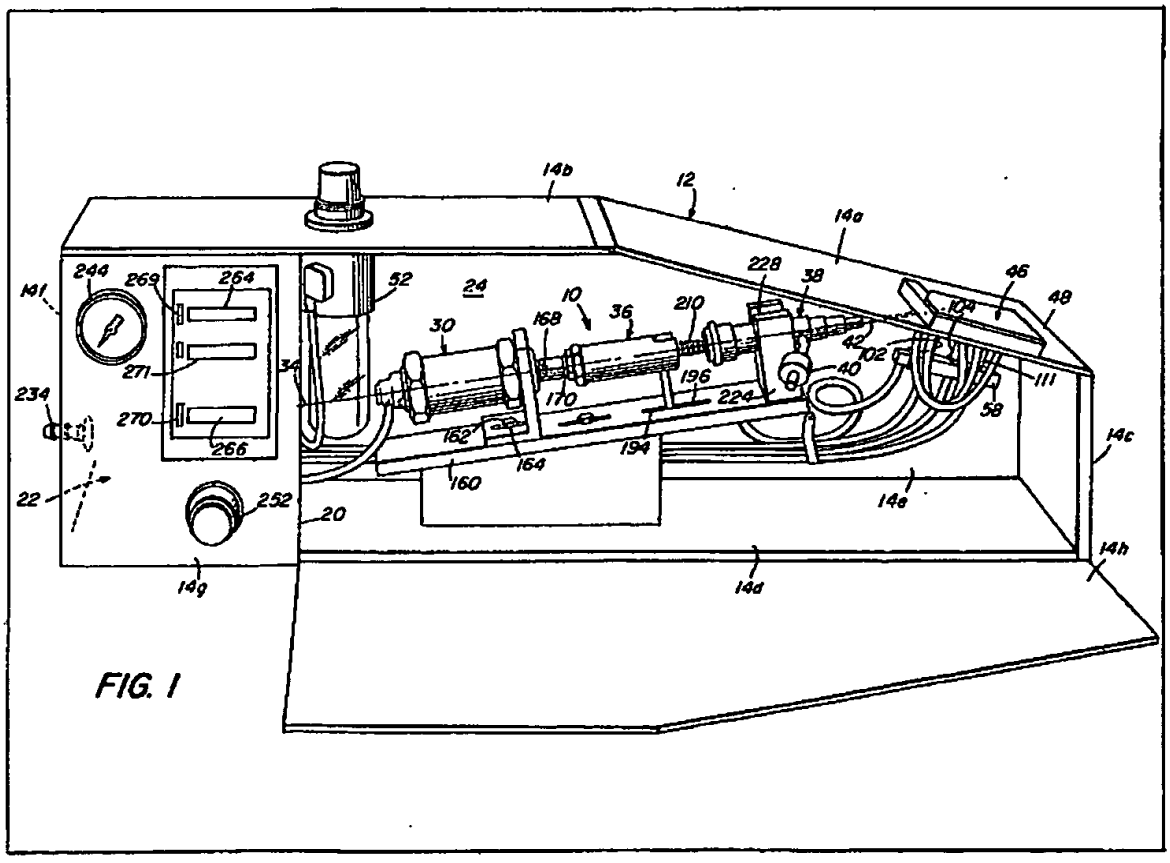

FIG. 1

GB 2 126 093 A

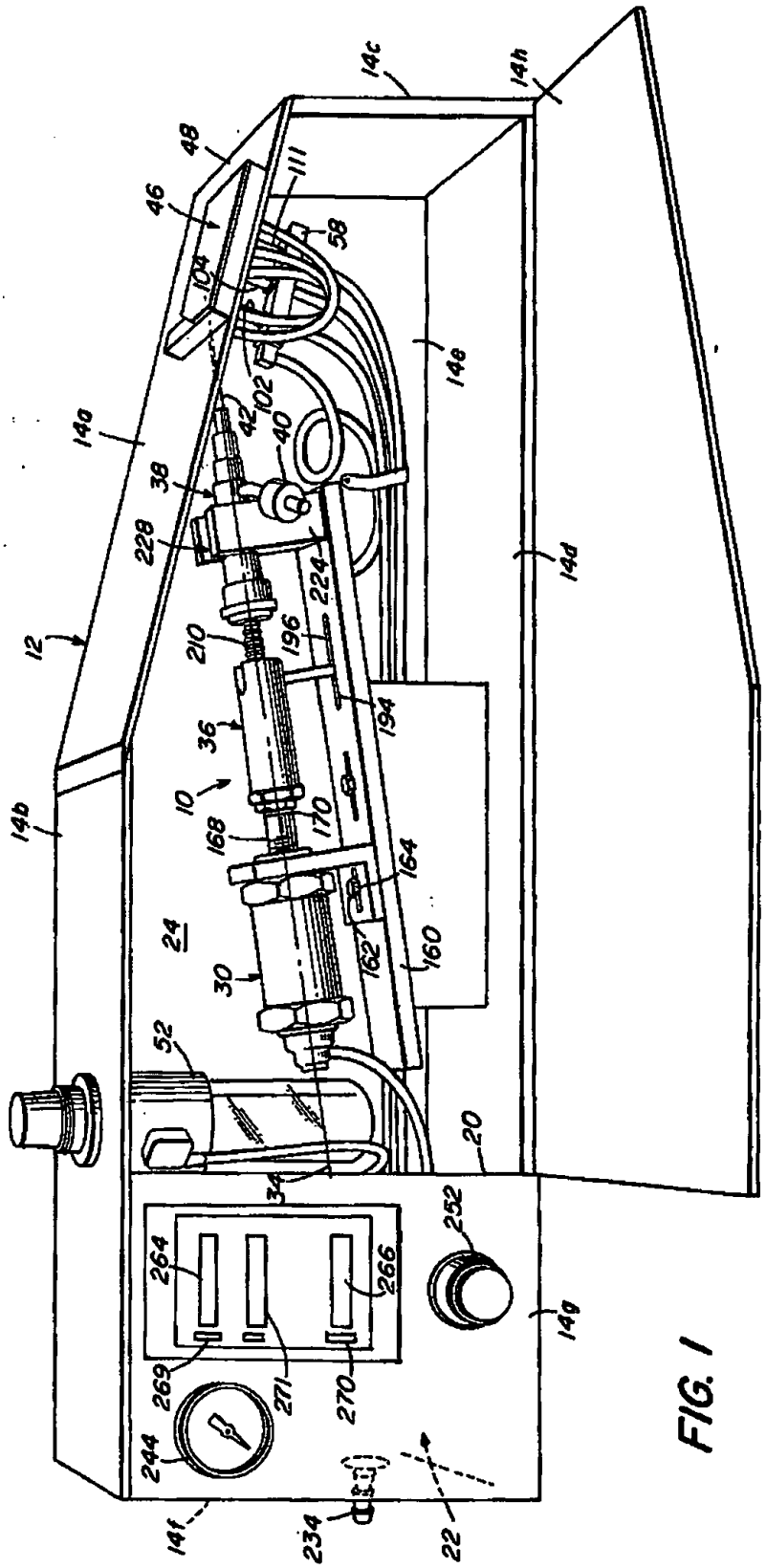
14c
14h
48
46
111
58
104
14e
102
42
40
140
38
228
224
14d
12
210
196
194
36
10
168
170
164
14b
24
160
162
30
52
20
34
252
264
266
14g
269
271
270
244
141
234
22

FIG. 1

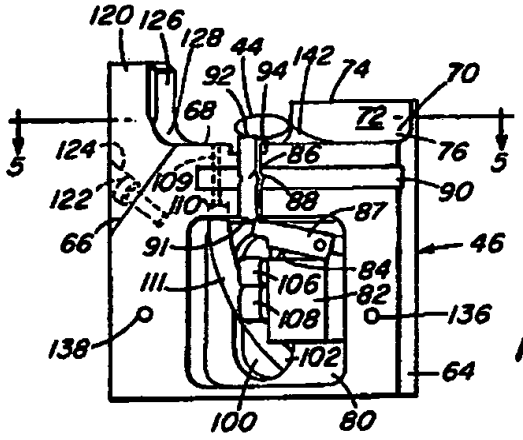

FIG. 2

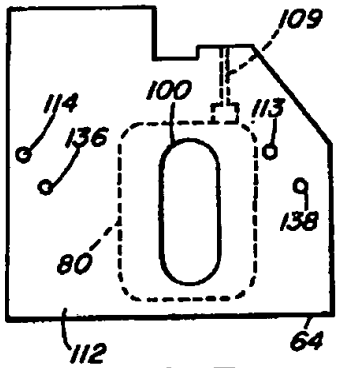

FIG. 3

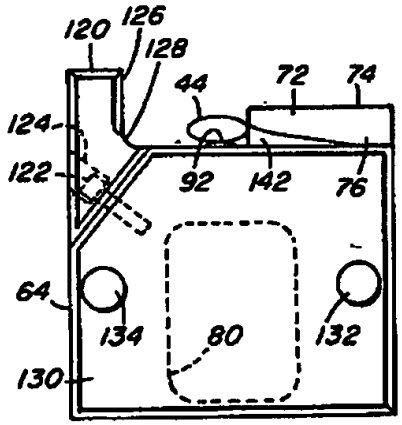

FIG. 4

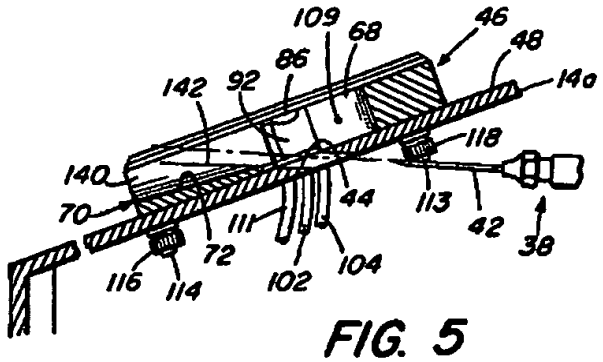

FIG. 5

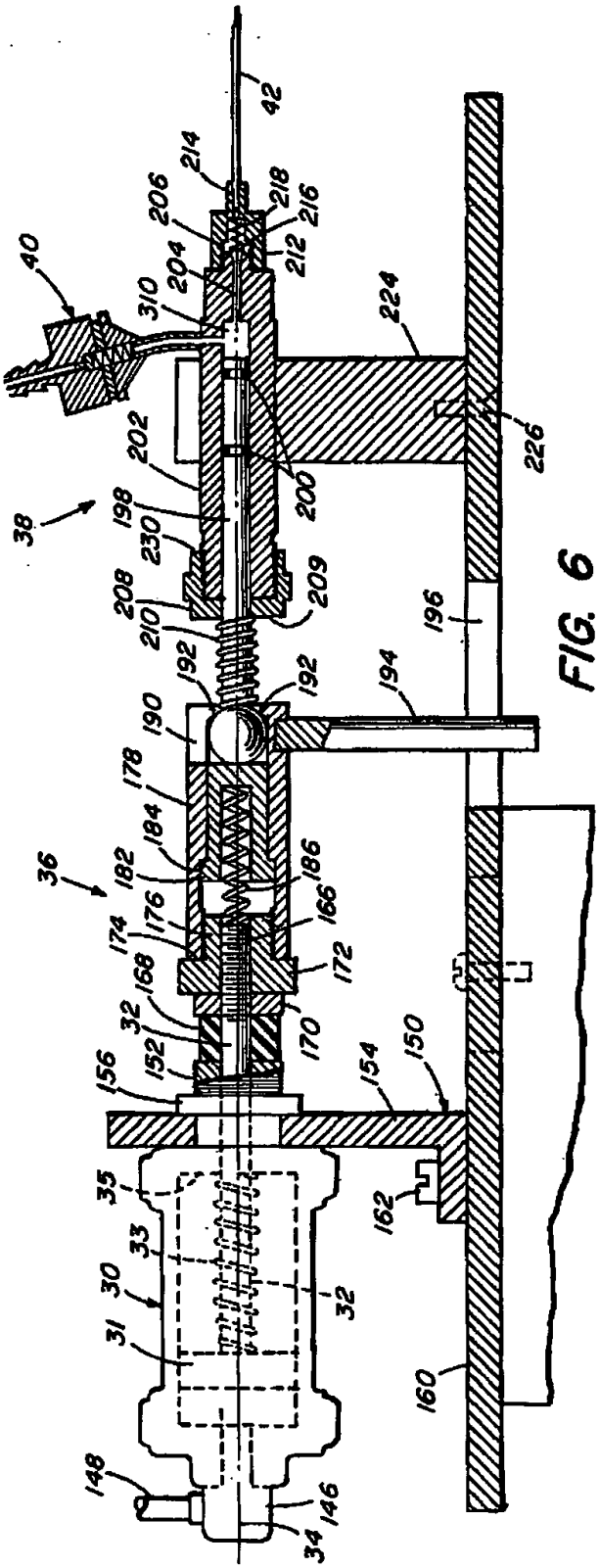

FIG. 6

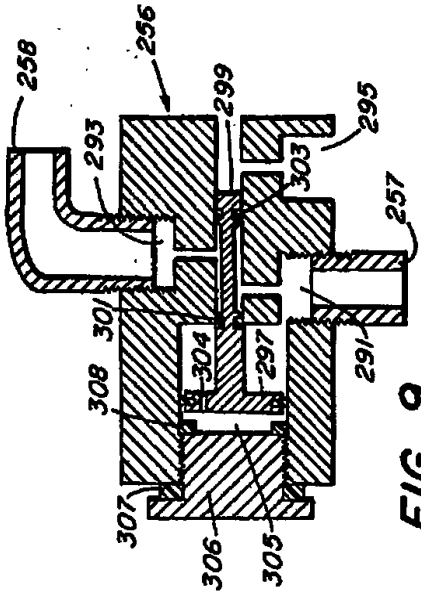

FIG. 9

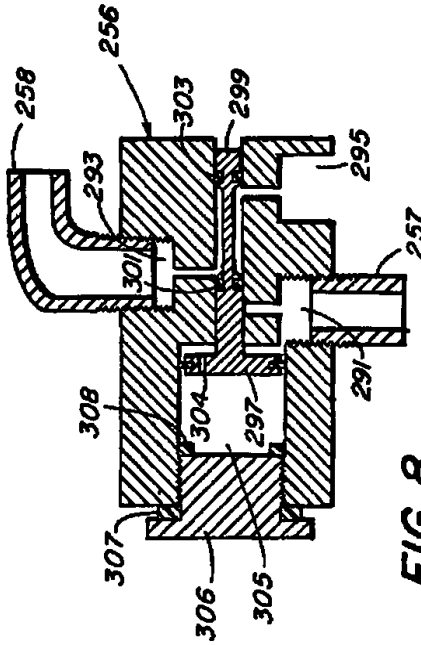

FIG. 8

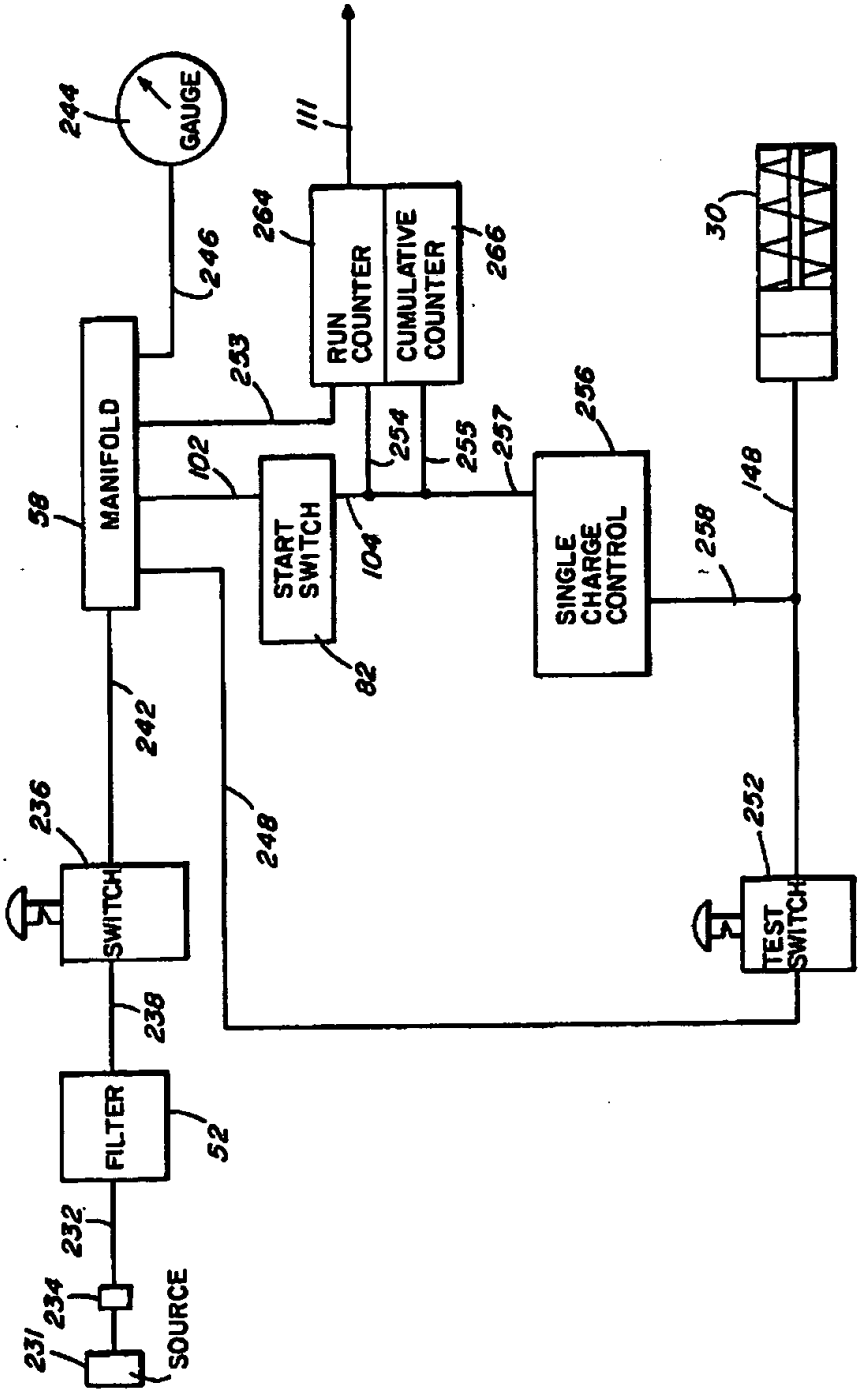
GAUGE
244
246
111
264
RUN COUNTER
CUMULATIVE COUNTER
266
30
253
MANIFOLD
58
102
START SWITCH
104
82
254
255
257
256
SINGLE CHARGE CONTROL
148
258
242
248
236
SWITCH
238
252
TEST SWITCH
FILTER
52
232
234
231
SOURCE

FIG. 7

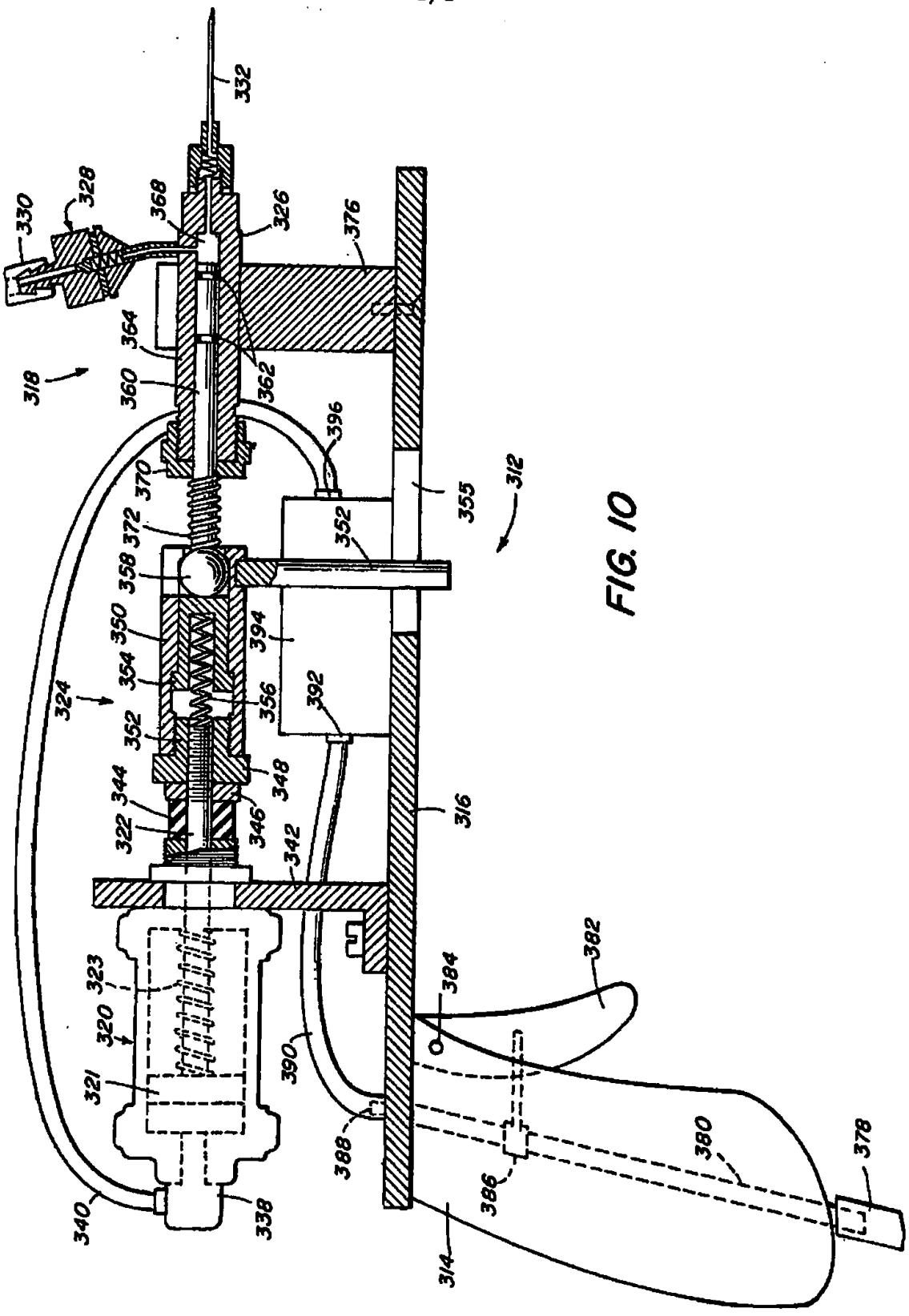
332
328
330
368
326
376
364
318
360
362
396
370
355
312
372
352
358
350
394
354
324
356
392
352
344
348
322
346
342
316
323
320
382
384
321
390
388
380
386
378
340
338
314

FIG. 10

SPECIFICATION

Improved pneumatic vaccinator

This invention relates generally to devices for automatically injecting a treatment liquid by means of a syringe into an animal, and particularly to pneumatically powered devices of this type.

In Gourlandt, U.S. Patent No. 4,177,810, issued December 11, 1979, there is described an automatic pneumatically operated injection apparatus for injecting a treatment liquid by means of a syringe into an animal. In the device described there, actuation is automatically started and pneumatic pressure is then maintained on the drive cylinder for a syringe. When a rod member extending downwardly from the forwardly moving syringe mechanically engages a camming element to open a pneumatic stop switch, other elements in the fluid logic circuitry operate to cut off the supply of fluid pressure to the drive cylinder. The drive rod is then allowed to retract.

It would be desirable to reduce the complexity of the pneumatic activation and deactivation function in such a device in order to reduce the problems of mechanical breakdowns, jamming, waste of pneumatic pressure, and so forth, and, particularly, to reduce the possibility of leaving the syringe in a forward, projecting position where harm to an animal, or an operator, could result, because of a failure of the retracting control elements. Furthermore, it would be desirable to provide a handheld pneumatic injector for use with large animals, and improving the pneumatic control system substantially contributes to achieving that goal.

Accordingly, it is an object of the invention to provide a pneumatically powered automatic fluid injection device for animals, with an improved pneumatic control system that is efficient, simple and inexpensive to manufacture and operate. It is another object of the invention to provide a pneumatically powered automatic fluid injection device that may be held conveniently by hand.

The present invention is an automatic veterinary injection apparatus comprising a fluid actuated drive cylinder having a driven rod extending from one end thereof, said rod translating along a longitudinal axis of said cylinder from a retracted position upon actuation of said cylinder, and having bias means for biasing said rod in said retracted position, a syringe displacement means connected to said rod for movement along the longitudinal axis of said displacement means, an injection syringe connected to said displacement means and having a syringe body provided with an injection-liquid supply, an injection needle secured to said syringe body, and a syringe piston slidably mounted within said syringe body, and slidable in response to said movement of said syringe displacement means, and fluid supply means comprising supply conduit means for connecting a supply of fluid under pressure to said apparatus, said actuating conduit means for connecting a supply of fluid to said drive cylinder, and valve means for connecting said supply conduit means to said actuating conduit means, said valve means being adapted to respond to an incoming supply of fluid under pressure from said supply conduit means by supplying fluid through said actuating conduit means to actuate said drive cylinder only once, for the apparatus to inject said injection-liquid into an animal, and thereafter to exhaust said drive cylinder, allowing the bias means to act on said rod to return said rod to its said retracted position.

In preferred embodiments the valve means includes passage-preventing means adapted to prevent fluid under pressure continuously applied to said supply conduit means from actuating the drive cylinder again after the rod has returned to its retracted position, and to allow fluid introduced under pressure to the supply conduit means after fluid under pressure has been first withdrawn from the supply conduit means to flow through the actuating conduit means to actuate the drive cylinder only once.

The present invention is also a method of operating an automatic pneumatic veterinary injection apparatus comprising a fluid actuated drive cylinder having a driven rod extending from one end thereof, said rod translating along a longitudinal axis of said cylinder from a retracted position upon actuation of said cylinder, and having bias means for biasing said rod in said retracted position, a syringe displacement means connected to said rod for movement along the longitudinal axis of said displacement means, an injection syringe connected to said displacement means and having a syringe body provided with an injection-liquid supply, an injection needle secured to said syringe body, and a syringe piston slidably mounted within said syringe body, and slidable in response to said movement of said syringe displacement means, the method comprising introducing into said cylinder an amount of fluid limited to that necessary to actuate said cylinder once.

Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:—

Fig. 1 is a side perspective view of one embodiment of an injection apparatus incorporating the invention;

Fig. 2 is a top plan view of the retention means of the apparatus with the top cover removed for clarity;

Fig. 3 is a bottom plan view of the retention means with the pneumatic related components removed for clarity;

Fig. 4 is a top plan view of the retention means with the top cover in place;

Fig. 5 is a cross-sectional view along lines 5—5 of Fig. 2;

Fig. 6 is a cross-sectional view of the mechanical drive system of the apparatus;

Fig. 7 is a circuit diagram of the pneumatic flow paths of the apparatus;

Fig. 8 is a cross-sectional view of the one-shot valve in the pneumatic control portion of the apparatus, showing its components at the

beginning and end of operation;

Fig. 9 is a view like that of Fig. 8, in which, however, the components of the valve are shown in a position in which the drive cylinder of the apparatus is being supplied with air pressure; and

Fig. 10 illustrates, somewhat diagrammatically, another embodiment of an injection apparatus incorporating the invention, of the hand-held type.

The automatic injection apparatus 10 is housed in a casing 12 having a plurality of side, top and bottom panels, 14*a*, 14*b*, . . ., 14*h*, and a partitioning panel 20. Partitioning panel 20 divides the interior of the casing 12 into two sections, a fluid control section 22 and a pneumatic drive section 24.

The fluid control section 22 houses most of the fluid circuitry required to instrument and control operation of the apparatus. The pneumatic drive section 24 houses primarily the mechanical drive system. A fluid actuated drive cylinder 30 has a piston 31 with a driven rod 32 which translates along a longitudinal axis 34 of the cylinder upon actuation of the cylinder (Fig. 6). A biasing spring 33 is coiled around the rod 32 between the piston 31 and the front wall of the cylinder. The spring 33 biases the rod 32 to its unextended position. The pneumatic drive section further contains a syringe displacement means 36 connected to the rod 32 for movement, in this embodiment, along the longitudinal axis 34 of the cylinder, and an injection syringe 38 connected to and driven by the syringe displacement means 36. A lateral injection-liquid supply tube 40 is connected to the injection syringe for supplying the liquid which will be injected into the animal. The injection syringe has secured at its forwardmost end a needle 42 which is translated through an aperture 44 (Fig. 2) in the top panel 14*a* to inject the liquid into an animal part being held against a retention means 46 secured against an outside wall portion 48 of the casing. The elements of the pneumatic section 24 are constructed in a modular form so that they can be easily disconnected both pneumatically and mechanically, for ease of maintenance and repair. The pneumatic section 24 also houses a fluid filter-regulator 52 and a release manifold mechanism 58.

Referring to Fig. 2, the retention means 46 comprises a thick plate 64, made, for example, of a lightweight alloy, having a substantially square or rectangular shape and having a planar main abutment face 66 and a planar first auxiliary abutment face 68, the two faces 66 and 68 forming an obtuse angle. Plate 64 further has an auxiliary portion 70 integral therewith. An elongated external surface 72 of the portion 70 is planar towards its external edge 74 and joins the abutment face 68 along a fraction of the length of the latter by an arcuate surface portion 76.

The thick plate 64 has an internal cavity 80 which contains a pneumatic start switch 82. Switch 82 has a movable element 84 which can be actuated by a push button 86 acting upon a pivoted cam member 87. Push button 86 is U-shaped, a central branch 88 of the U-shaped push button being located in a groove 90 of the plate 64. One of the lateral branches 91 of the "U" is in contact with the pivoted cam member 87 and the other branch 92 of the "U" is more or less "introduced" into a cavity 94 over the whole height of the abutment face 68 and is pushed or urged towards the bottom of the cavity 94. When the movable element 84 is pushed (downward in Fig. 2), thereby actuating pneumatic start switch 82, the injection operation is immediately started. The pneumatic start switch is generally actuated through movable element 84 when a limb or other part of an animal is applied against the abutment face 68.

Cavity 80 has an aperture 100 through which at least two flexible tubular conduits 102, 104 pass and connect to the pneumatic start switch 82 inside the cavity 80 at terminals 106, 108 respectively. It is through these tubular conduits that the pneumatic start switch is connected to the rest of the fluid circuitry to control the beginning of each injection operation as described in more detail below.

Fig. 3 shows the lower or bottom surface 112 of plate 64 which is normally applied against the top pivotal panel 14*a*. The surface 112 is secured on panel 14*a* by, for example, threaded rods 113, 114 which may be engaged by serrated or embossed nuts 116, 118.

Referring to Figs. 2 and 4, the retention means is also provided with a removable member 120 which is rigidly secured to thick plate 64 along the abutment face 66 by means of a screw 122, the head of which is located in a duct 124 of member 120. The screw head rests on an inner peripheral shoulder of the duct. The thickness of member 120 is substantially the same as that of the thick plate 64 so that continuity is ensured from the abutment face 68 of plate 64 to a short abutment plane face 126 of the member 120 by an interconnecting arcuate face 128.

The thick plate 64 is also provided with a top cover 130 having a bevelled peripheral edge. Cover 130 is secured to plate 64 by screws 132, 134 having serrated or knurled heads. Screws 132, 134 are screwed into threaded bores 136, 138 respectively of plate 64 (Figs. 2 and 3).

Referring to Fig. 5, the interrelationship of the components of retention means 46 of Figs. 2—4 with respect to the top panel 14*a*, including the aperture 44 and the needle end of the injection syringe, in the injection state, is shown. The injection syringe 38 with its needle 42 is adapted to pass through aperture 44 as noted above. An incurved surface portion 140 of auxiliary portion 70 is slightly bevelled in its lower portion, the bevelling plane being referred to by a number 142. Incurved surface portion 140 is also slightly inclined to the exterior surface of the top panel 14*a*.

Referring now to Fig. 6, the fluid actuated drive cylinder 30 is provided with a fluid pressure input, preferably compressed air, through an inlet valve 146 from a flexible supply conduit 148. Cylinder 30 is a standard commercially available cylinder,

such as those manufactured by Shrader Manufacturing Company, having manufacturing offices located worldwide. The cylinder 30 is secured to and supported by a cylinder support member 150. A threaded support end 152 of cylinder 30 extends through an aperture in a vertically disposed portion 154 threaded onto the threaded support end 152 of cylinder 30. The cylinder support 154 is bolted to a main body support plate 160 by screws 162 extending through slotted apertures 164 in member 150.

Extending outward past the threaded support end 152 of cylinder 30 is the driven rod 32 of the cylinder. Driven rod 32 is threaded at its driving end 166.

The syringe displacement means 36 comprises a first shock absorbing member 168 which, in the illustrated embodiment, makes a press fit with an unthreaded portion of rod 32, has a substantially hollow cylindrical shape, is mounted adjacent threaded support end 152, and is held in place by a nut 170. Member 168 may be composed of any suitably resilient material, for example, a hard rubber compound. A threaded size converting member 172 is threaded onto end 166 of rod 32 and is tightened and secured against nut 170. Member 172 has an annular abutment shoulder 174 and a threaded portion 176 which is engaged by a hollow displacement member 178.

Positioned within hollow member 178 is a second hollow member 180 having an enlarged portion 182 which rests against an abutment shoulder 184 of hollow member 178. Hollow member 180 is forced forward in hollow member 178 by a stiff shock absorbing spring 186 which engages a rod 32 at one end and the forward interior surface of hollow member 180 at its other end.

The forward end of hollow member 178 has a substantially circular shaped top opening 190 which allows a ball shaped end of injection syringe 38 to be pivotably and releasably press fit into the hollow forward portion of member 178. The ball shaped portion is held within the hollow forward portion by inwardly directed lips 192 of member 178. Hollow member 178 further has a downwardly extending rod member 194 which passes through an aligned slotted aperture 196 in the main body support plate 160.

The injection syringe 38 comprises a rod or piston member 198 which has at its forward end two spaced "O" rings 200 which sealingly mate with the interior surface of a hollow syringe body member 202. Body member 202 has a narrow cylindrical passage 204 at its forward end which terminates in a narrow, exteriorly threaded, forward portion 206. The rearward portion of body member 202 is also threaded and seats in the internal threads of a C-shaped cup member 208. Cup member 208 has an aperture in its body portion 209 through which rod member 198 passes. A spring 210 is provided between C-shaped cup member 208 and the ball shaped end of rod 198. Threaded onto the forward end of body member 202 is a hollow syringe member 212 having a constricted opening 214 at its forward end. Seated within the narrow cylindrical passage 204 of hollow member 202 is a plunger shaped element 216, held in position by a spring member 218. The needle 42 is secured in constricted opening 214.

The injection syringe member 38 is slidably supported by a grooved syringe support member 244 secured to main body support plate 160, for example by screws 226. The body member 202 makes a sliding fit within a grooved portion 228 of support member 224 which allows the injection syringe to slidably translate in response to a driving force provided through rod 198 and spring 210. The amount of displacement of the injection syringe body member 202 is limited because a forward end 230 of C-shaped cup member 208 engages the support member 224 during its forward movement.

The injection syringe can also be pivoted upward, away from the support 224 and about the ball shaped or spherical end of rod 198, to enable the syringe members to be more easily accessed and maintained.

The Fluid Circuit

Referring now to Fig. 7, the pneumatic components are configured in a circuit for effecting repetitive actuation of the drive cylinder 30. An external high pressure fluid source 231, preferably compressed air, is connected to an internal input conduit 232 through an input terminal 234 attached to the casing 12 at side panel 14f.

The internal input conduit 232 is connected to the filter-regulator 52 which is a commercially available unit such as, for example, Schrader Scovitt Type No. B 260C, where the incoming air is filtered and regulated to a reduced pressure. The output of the regulator 52 is conducted to a push-button pneumatic switch or circuit breaker 236 through a flexible conduit 238. A flexible conduit 242 from the switch 236 connects the switch 236 to the input of manifold 58. The manifold 58 has four output conduits: a conduit 102 connected at its other end to the pneumatic start switch 82, a conduit 246 connected at its other end to a pressure gauge 244 that monitors the output of the filter-regulator 52, a conduit 248 connected at its other end to a test push-button pneumatic switch or circuit breaker 252, and a conduit 253 connected to a run counter 264. The fluid circuit in the preferred embodiment includes the run counter 264 and a cumulative counter 266, which register respectively the number of doses administered over a selected time span, for example, one day. Run counter 264 is especially useful because in the preferred embodiment it is preset to a selected number whereby when the counter reaches that number, a gas flow through an output conduit 111 is initiated. The gas flow through conduit 111 provides the gas flow at flowpath 109 of the retention means.

The output conduit 104 from the start switch 82 is connected to a conduit 254 connected to

the run counter 264 and is also connected to a conduit 255 connected to the cumulative counter 266, to trigger them when the start switch is closed. The output conduit 104 is also connected to the input of a single charge pneumatic control 256 by a supply conduit 257. The single charge pneumatic control 256 is a conventional valve, such as that sold under the designation OS-1 by Fabco-Air of Gainesville, Florida 32601. The control valve 256 responds to an increase in fluid pressure (such as air pressure) at its input by producing at its output a limited charge of fluid. In the preferred embodiment the limited charge is of air sufficient to cause the rod member 32 in the drive cylinder 30 to move forward and force vaccine or other liquid through the injection needle 42. The single charge output of the single charge valve 256 is transmitted to the drive cylinder 30 by a conduit 258.

The single charge valve 256 is shown in cross-sectional views that show the inner passages of the valve in Figs. 8 and 9. As shown in those figures, the valve 256 has an inlet 291, an outlet 293, and an exhaust 295, all connected by internal passages. A valve piston head 297 is mounted at the head of a valve piston stem 299, which in addition has a front small O-ring 301 and a rear small O-ring 303. The valve piston head 297 has a small relief hole 304 that allows the passage of air from one side of the piston head 297 to the other in an amount determined by the required characteristic of the valve, in a manner well known to those skilled in the art. In the preferred embodiments, the valve 256 is selected to match the capacity of the drive cylinder 30, and the size of the relief hole 304 is selected to determine the rapidity of the cycles of operation of the valve 256.

The space 305 between the valve piston head 297 and a plug 306 screwed into an end of the valve 256 forms an air trap against which the valve piston head 297 must press if it is to move forward (to the left in Figs. 8 and 9). The plug 306 has a sealing ring 307 where the plug 306 meets the valve 256. An O-ring 308 is located at the base of the plug 306, facing the valve piston head 297. The supply conduit 257 to the valve 256 supplies the valve inlet 291 with air under pressure when the start switch 82 is in the open position. When the start switch 82 is closed, air in the inlet 291 returns to the ambient pressure.

System Operation

The apparatus is made operational by using the first switch 236 to connect the rest of the pneumatic circuit to the filtered and pressure regulated air available in the conduit 238 as the output of the filter regulator 52. The counters may be manually reset by depressing front panel bottoms 269, 270. The run counter 264 may be reset at the end of every run and the cumulative counter 266 at the beginning of a selected longer time span. The number of injections to be allowed for each run is set in selector 271, a part of the counter assembly (Fig. 1), and the retention means is aligned with the injection needle. The machine is then ready to be used.

The first animal is positioned at the retention means, and in doing so, the push button operated pneumatic start switch 82 is opened, i.e., passes fluid, thereby providing fluid pressure at its output on conduit 104. The output of the start switch 82 actuates the run counter 264 and the cumulative counter 266 each for one count and provides an input to the single charge control valve 256. The output of the single charge control valve 256 is transmitted over its output conduit 258 and the cylinder input conduit 148 to the drive cylinder 30.

In response to the fluid input over the conduit 148, the cylinder 30 is actuated, causing its rod member 32 to be displaced in the forward direction from its normal retracted state to which it is biased by spring 33, to an injection state. As rod member 32 is initially displaced in the forward direction, so are syringe displacement means 36 and injection syringe 38, and as the displacement means 36 and hence injection syringe 38 are urged forward, the forward end 230 of C-shaped member 208 engages syringe support member 224, which stops the forward motion of body member 202. (This determines the forwardmost needle position.) The syringe displacement means is, however, still urged forward (driving rod 198 forward with respect to body member 202) and vaccine or other liquid is ejected through the injection needle 42 into the animal part.

Referring to Figs. 8 and 9, one can see how the single charge valve 256 operates to achieve the effect just described. At the beginning of operation, ambient air pressure exists in all passages of the valve 256, including the air trap 305, and the position of the valve piston head 297 and the valve piston stem 299 are shown in Fig. 8. When the start switch 82 is opened during operation of the apparatus, air pressure is introduced, *via* the supply conduit 257, to the inlet 291 of the valve 256. This results in a higher pressure on the rear of the valve piston head 297 and the piston head 297 moves forward to the position shown in Fig. 9. The movement forward of the piston head 297 compresses the air trapped in the air trap 305 ahead. Meanwhile, however, the movement forward of the piston stem 299 and the front and rear small O-rings 301, 303 opens a passage from the valve inlet 291 to the valve outlet 293, which is connected to the drive cylinder 30 by the actuating conduit 258.

Air under pressure passes through the actuating conduit 258 and the drive cylinder 30 is actuated, moving the rod member 32 forward from its retracted position, against the bias of the spring 33.

Meanwhile the piston head 297 begins to move back from its forward position (Fig. 9) to its rearward position (Fig. 8). The valve 256 is matched to the drive cylinder 30 so that the piston head 297, and piston stem 299, move back to the position of Fig. 8 (to shut off air supply from the inlet 291 to the outlet 293, and open the outlet

293 to the exhaust 295) only after sufficient time has elapsed to allow the drive cylinder 30 to operate fully once and allow the injection of an animal with injection fluid. With the valve piston head 297 and stem 299 in the position shown in Fig. 8, air in the drive cylinder 30 exhausts through the actuator conduit 258 and the exhaust 295 of the valve 256, and the bias spring 33 returns the drive rod 32 to the retracted position.

The maintenance of air pressure at the valve inlet 291 after the actuation once of the drive cylinder 30 will not cause a second actuation, because enough air under pressure has now leaked through the relief hole 304 in the piston head 297 during operation of the valve that air pressure is the same on both sides of the piston head 297 and the piston head 297 does not move. While piston head 297 is in this position (Fig. 8) the front small O-ring 301 prevents passage of air from the supply conduit 257 through the valve 256 to the actuating conduit 258.

If air pressure at the inlet 291 is removed, as by release of the start switch 82, the piston head 297 will still remain in the position shown in Fig. 8. Air pressure on both sides of the piston head 297 will return to ambient. If the start switch 82, however, is opened again, and air under pressure is re-introduced to the valve inlet 291, the cycle described above will be repeated, and the drive cylinder 30 and the injection syringe 38 will be actuated again.

As noted above, when run counter 264 reaches the preselected count, it initiates an air flow signalling system to warn the operator that the preselected number has been reached.

The operation of cylinder 30 by displacement of its rod 32 initiates a "dual displacement" of the displacement means 36 and injection syringe 38. Thus, as rod 32 moves forward, the displacement means 36 and the injection syringe 38 are displaced in a forward direction, substantially as a unit, until C-shaped cup member 208 engages syringe support member 224 whereby movement of hollow body member 202 terminates. However, the rod 32 continues to move forward, forcing displacement means 36 to move forward. As a result, second hollow member 180 acts on the ball shaped end of rod shaped member 198 with a predetermined pressure fixed by a spring 186 (which also absorbs some of the "shock" when C-shaped cup 208 engages the spring support), to force rod 198 forward relative to body member 202. Thereby, a measured quantity of vaccine or other liquid supplied by tube 40 to fill hollow chamber 310, is forced out through the injection needle 42, which by that time has already pierced the skin of the animal positioned at the retention means.

The apparatus can also be manually tested by using the test switch or circuit breaker 252. By depressing the actuating push button of switch 252, the output conduit 148 is connected to pressurized conduit 242. As a result, the injection syringe is displaced to its injection state by rod 32 and rod 32 is urged to its forwardmost position. In this manner the mechanical drive system and the retention means can be aligned with each other and with aperture 44.

Fig. 10 illustrates another pneumatic vaccinator 312 that is of a handheld type. The vaccinator includes a handle 314, a horizontal support plate 316 from which the handle 314 downwardly extends, and a pneumatic drive assembly 318 mounted on the support plate 316.

The pneumatic drive assembly 318 includes a fluid actuated drive cylinder 320 with a piston 321, a driven rod 322, a bias spring 323, a syringe displacement means 324, an injection syringe 326, a lateral injection liquid supply tube 328 connected by a flexible conduit 330 to a supply of injection liquid not shown in the drawing, and an injection needle 332. The interrelationship of these and other elements of the pneumatic drive assembly 318, unless otherwise noted, is the same as the equivalent elements of the first embodiment, and reference to the description of the first embodiment will provide detail for the elements of the pneumatic drive assembly 318 which are described here in more general terms.

The fluid actuated drive cylinder 320 is provided with a fluid pressure input, preferably compressed air, through an inlet valve 338 from a flexible actuating conduit 340. The cylinder 320 is supported by a vertical support plate 342 mounted on the horizontal support plate 316.

The syringe displacement means 324 has a shock absorbing member 344 press fit on the rod 322 between the drive cylinder 30 and the unit comprising the nut 346, the size converting member 348, the hollow member 350 to which the downwardly extending rod 352 is attached, and an interior hollow member 354. The downwardly extending rod 352 passes through a slot 355 in the horizontal support plate 316. The interior hollow member 354 is forced forward by a shock absorbing spring 356.

The ball shaped end 358 of a syringe rod 360 is pivotably and releasably press fit into the hollow forward portion of the hollow member 350. The syringe rod 360 carries two spaced "O" rings 362 that sealingly mate with the interior surface of a hollow syringe body member 364 so that forward movement of the syringe rod 360 expels through the injection needle 332 liquid supplied to the forward hollow chamber 368 of the syringe by the supply tube 328. A C-shaped cup member 370 is mounted on the rear of the injection syringe 326, and a spring 372 is provided between the cup member 370 and the ball shaped end 358 of the syringe rod 360. The C-shaped cup member 370 limits forward movement of the syringe 326 by engaging the syringe support member 376 mounted on the horizontal support plate 316.

The fluid circuit of the second embodiment shown in Fig. 10 comprises a flexible conduit 378 carrying fluid under pressure (such as compressed air) from a conventional source not shown on the drawing, to a fluid passage 380 in the handle 314. A trigger 382, pivotally mounted on a pin 384 in

the handle 314 controls a pneumatic on-off valve or switch 386 in the path of fluid passage 388. The handle fluid passage 380 terminates in a connection 388 on the side of the switch 386 opposite the input conduit 378. A flexible supply conduit 390 connects the fluid passage 380 *via* the connection 386 to the intake connection 392 of a single charge pneumatic control 394 such as that sold under the designation OS-1 by Fabco-Air of Gainesville, Florida 32601. The output terminal 396 of the single charge control 394 is connected to the flexible cylinder input conduit 340.

The handheld pneumatic vaccinator 312 of Fig. 10 is operated by squeezing the trigger 388 to open the valve or switch 386 to allow a pressurized fluid, such as compressed air, to come through the handle fluid passage 380, and through the flexible supply conduit 390 connected to the input 392 of the single charge pneumatic control 394. The output of the single charge control 394 is transmitted over the actuating conduit 340 to the drive cylinder 320.

The drive cylinder 320 responds to the fluid input through the actuating conduit 340 by causing the rod member 322 to go forward against the bias of the spring 323, and therefore the syringe displacement means 324 and the injection syringe 326 also go forward. When the C-shaped member 370 engages the syringe support member 376, the forward motion of the syringe 326 is stopped, but the syringe rod 360 continues forward, and vaccine or other liquid is ejected through the injection needle 332 into the animal against which the handheld vaccinator is aimed. Since air was supplied to the drive cylinder 320 only long enough to advance the rod 322 to its extended state, the rod 322 soon responds to its bias spring 323 to retract to its unextended state, and the syringe 326 withdraws also.

The reaction of the rod in the drive cylinder of both the embodiments described to the bias spring is dependable, because of the simplicity and directness of the action of the spring on the rod. The single charge valve, in combination with the bias spring, assures that the rod and syringe will not inadvertently be actuated to the forward, extended position and left there through failure of an elaborate retracting control system.

CLAIMS

1. Automatic veterinary injection apparatus comprising a fluid actuated drive cylinder having a driven rod extending from one end thereof, said rod translating along a longitudinal axis of said cylinder from a retracted position upon actuation of said cylinder, and having bias means for biasing said rod in said retracted position, a syringe displacement means connected to said rod for movement along the longitudinal axis of said displacement means, an injection syringe connected to said displacement means and having a syringe body provided with an injection-liquid supply, an injection needle secured to said syringe body, and a syringe piston slidably mounted within said syringe body, and slidable in response to said movement of said syringe displacement means, and fluid supply means comprising supply conduit means for connecting a supply of fluid under pressure to said apparatus, actuating conduit means for connecting a supply of fluid to said drive cylinder, and valve means for connecting said supply conduit means to said actuating conduit means, said valve means being adapted to respond to an incoming supply of fluid under pressure from said supply conduit means by supplying fluid through said actuating conduit means to actuate said drive cylinder only once, for the apparatus to inject said injection-liquid into an animal, and thereafter to exhaust said drive cylinder, allowing said bias means to act on said rod to return said rod to its said retracted position.

2. Apparatus as claimed in claim 1, wherein said valve means includes passage-preventing means adapted to prevent fluid under pressure continuously applied to said supply conduit means from actuating said drive cylinder again after said rod has returned to its said retracted position.

3. Apparatus as claimed in claim 2, wherein said passage-preventing means is adapted to allow fluid introduced under pressure to said supply conduit means to flow through said actuating conduit means to actuate said drive cylinder only once, after fluid under pressure has been first withdrawn from said supply conduit means.

4. Automatic veterinary injection apparatus comprising a fluid actuated drive cylinder having a driven rod extending from one end thereof, said rod translating along a longitudinal axis of said cylinder from a retracted position upon actuation of said cylinder, and having bias means for biasing said rod in said retracted position, a syringe displacement means connected to said rod for movement along the longitudinal axis of said displacement means, an injection syringe connected to said displacement means and having a syringe body provided with an injection liquid supply, an injection needle secured to said syringe body, and a syringe piston slidably mounted within said syringe body, and slidable in response to said movement of said syringe displacement means, and fluid supply means comprising a single charge pneumatic control means having an input connection and an output connection, said pneumatic control means being matched to said drive cylinder and adapted to respond to an increase in fluid pressure at said input connection by allowing fluid through its said output connection long enough only to actuate said cylinder once, means for connecting and disconnecting a supply of fluid under pressure to said input connection, and means for connecting said output connection to said drive cylinder.

5. A method of operating an automatic pneumatic veterinary injection apparatus comprising a fluid actuated drive cylinder having a driven rod extending from one end thereof, said rod translating along a longitudinal axis of said cylinder from a retracted position upon actuation of said cylinder, and having bias means for biasing

said rod in said retracted position, a syringe displacement means connected to said rod for movement along the longitudinal axis of said displacement means, an injection syringe connected to said displacement means and having a syringe body provided with an injection-liquid supply, an injection needle secured to said syringe body, and a syringe piston slidably mounted within said syringe body, and slidable in response to said movement of said syringe displacement means, the method comprising introducing into said cylinder an amount of fluid limited to that necessary to actuate said cylinder once.

6. Automatic veterinary injection apparatus substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.

7. A method as claimed in claim 5 and substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1984. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.